

PATENT COOPERATION TREATY

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NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 15 May 2000 (15.05.00)	
International application No. PCT/GB99/03169	Applicant's or agent's file reference PBA/D088262PWO
International filing date (day/month/year) 11 October 1999 (11.10.99)	Priority date (day/month/year) 09 October 1998 (09.10.98)
Applicant KAY, John, Granville et al	

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

31 March 2000 (31.03.00)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Christine Carrié Telephone No.: (41-22) 338.83.38
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PATENT COOPERATION TREATY

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From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

To:

ATKINSON, Peter, Birch
Marks & Clerk
Sussex House
83-85 Mosley Street
Manchester M2 3LG
ROYAUME-UNI

Date of mailing (day/month/year)
26 June 2000 (26.06.00)

Applicant's or agent's file reference
PBA/D088262PWO

International application No.
PCT/GB99/03169

IMPORTANT NOTIFICATION

International filing date (day/month/year)
11 October 1999 (11.10.99)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address

JAMES HALSTEAD LIMITED
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State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☒ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address

POLYFLOR LIMITED
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State of Residence

GB

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3. Further observations, if necessary:

A signed power of attorney is required from the applicant appearing in Box 2 above.

4. A copy of this notification has been sent to:

☒ the receiving Office ☐ the designated Offices concerned
☐ the International Searching Authority ☒ the elected Offices concerned
☒ the International Preliminary Examining Authority ☐ other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

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Authorized officer

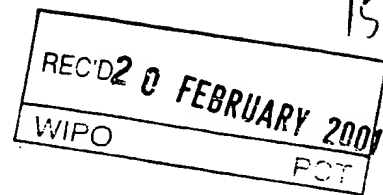
R. Chrem

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PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PBA/D088262PWO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/03169	International filing date (day/month/year) 11/10/1999	Priority date (day/month/year) 09/10/1998
International Patent Classification (IPC) or national classification and IPC D06N7/00		
Applicant POLYFLOR LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.


2. This REPORT consists of a total of 5 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 31/03/2000	Date of completion of this report 16.01.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer De Waha, R Telephone No. +49 89 2399 8306



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/03169

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

Description, pages:

1-11 as originally filed

Claims, No.:

14-25 as originally filed

1-13 as received on 11/11/2000 with letter of 06/11/2000

Drawings, sheets:

1/1 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/03169

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-25
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-25
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-25
	No:	Claims	

2. Citations and explanations
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

RE ITEM V

1. Novelty

Claims 1-9 relate to the floor coverings as such.

The first claim has been amended in such a way as to clarify that the aggregate is embedded in the PVC layer whilst being exposed at the surface of the barrier layer.

EP-A-0 494 658 (D1) describes PVC floor mat materials which are rendered non-slip and exhibit good wear characteristics (col 13, l. 30 - 36).

The example of D1 relates to a curable polyester urethane acrylate resin mixture (col. 10 l. 45 - col. 11, l. 44) to which aluminium oxide aggregate is added, this mixture being applied to a 6 mil PVC film which is then cured by electron beam irradiation (col.11, l. 45 - col 12, l. 30). The sheets produced are bonded to PVC floor mats by coextrusion (col. 12, l. 31-37).

It follows from this teaching that the aggregate is embedded within the top layer (not within the PVC layer).

This is not the case in the present invention, as the Applicant uses a plastisol upon which the aggregate is applied, entailing the effect of embedding the aggregate into the PVC layer.

It is concluded that the floor coverings according to claims 1 - 9 are novel (Art 33(2) PCT).

The same holds true for method claims 10 to 25. Claim 10 describes a process where aggregate (together with a heat fusible polymer) is distributed over a plastisol with subsequent heat fusing of both the plastisol and the barrier polymer, the aggregate thus being embedded within the PVC layer whilst also being exposed at the surface of the material.

None of the prior art discloses a process with these features, the subject-matter of claims 10 to 25 is therefore novel as well.

2. Inventive step

As D1 relates to the same problem as the the application (PVC - based floor covering material rendered non-slip by binding aggregate into the surface), D1 is considered to represent the closest prior art.

The distinguishing feature between the prior discussed above under Novelty lies in the feature that in the present invention, the aggregate is embedded within the PVC layer whilst at the same time the aggregate is exposed at the surface and the PVC layer as such is not exposed towards the surface as the barrier layer is covering it, adhering firmly to it as it is fused into the upper PVC layer.

None of the prior art discloses floor coverings showing these features.

The problem solved by these distinguishing features is to provide other PVC-based floor covering materials with good anti-slip and anti-stain properties.

An inventive step can therefore be recognized as regards claims 1-9 (Art 33(3) PCT).

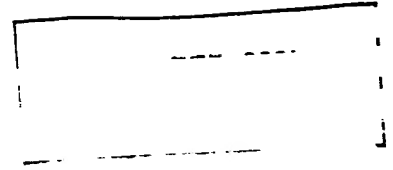
As regards method claims 10 - 25, none of the prior art discloses a process where a plastisol is coated with a mixture of aggregate and a polymer which is heat fusible to form a barrier layer; an inventive step can be recognized.

R ITEM VIII

Method claim 10 stipulates that "steps b) and c) must be effected such that aggregate is embedded in the PVC layer whilst also being exposed at the surface". The wording of the claim might be considered to be unclear as one might argue that the applicant is trying to define the invention by the aim to be achieved (R. 6 PCT).

However, Applicant has shown and discussed in the description that there are different ways to achieve the effect mentioned above.

It therefore appears that the claim is clear for the skilled person.



CLAIMS

1. A floor covering material comprising a PVC layer and having aggregate embedded in the material for providing surface roughness wherein the material incorporates a barrier layer of polymeric material other than PVC fused into the upper surface of the PVC layer, the aggregate being embedded in the PVC layer whilst also being exposed at the surface of the barrier layer.
2. A material as claimed in claim 1 wherein the barrier layer is of a cured polymeric material.
3. A material as claimed in claim 1 wherein the barrier layer is of a thermoplastic material.
4. A material as claimed in any one of claims 1 to 3 wherein the barrier layer is at least as flexible as the underlying PVC layer.
5. A material as claimed in any one of claims 1 to 4 wherein the barrier layer is transparent or translucent.
6. A material as claimed in any one of claims 1 to 5 wherein the polymeric material of the barrier layer provides enhanced dirt release and/or stain resistance in comparison to the PVC.
7. A material as claimed in any one of claims 1 to 6 wherein the barrier layer comprises a polyolefin, (co-)polyester, (co-)polyamide, polyurethane, phenol formaldehyde, epoxy or acrylic polymer or a mixture thereof.

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8. A material as claimed in any one of claims 1 to 7 wherein the floor covering material has an embossed surface.
9. A material as claimed in any one of claims 1 to 8 wherein the aggregate is quartz, corundum, and/or silicon carbide.
10. A method of producing a floor covering material comprising
 - (a) spreading a PVC plastisol on a substrate,
 - (b) distributing over the surface of the plastisol a powder of a film forming, heat fusible polymeric material other than PVC and a particulate aggregate material, and
 - (c) effecting heating to fuse the plastisol and convert the powder into a film,steps (b) and (c) being effected such that aggregate is embedded in the PVC layer whilst also being exposed at the surface of the film.
11. A method as claimed in claim 10 wherein the powder is distributed over the plastisol prior to the aggregate material.
12. A method as claimed in claim 11 wherein the powder applied to the plastisol is softened prior to distribution of the aggregate.
13. A method as claimed in claim 10 wherein the powder is distributed over the plastisol simultaneously with the aggregate.

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : D06N 7/00, B29C 70/64	A1	(11) International Publication Number: WO 00/22225 (43) International Publication Date: 20 April 2000 (20.04.00)
<p>(21) International Application Number: PCT/GB99/03169</p> <p>(22) International Filing Date: 11 October 1999 (11.10.99)</p> <p>(30) Priority Data: 9822019.7 9 October 1998 (09.10.98) GB</p> <p>(71) Applicant (for all designated States except US): JAMES HALSTEAD LIMITED [GB/GB]; P.O. Box 3, Radcliffe New Road, Whitefield, Manchester M45 7NR (GB).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): KAY, John, Granville [GB/GB]; 5 White Brow, Bury, Manchester BL9 8BT (GB). MINETT, Michael, Geoffrey [GB/GB]; 14 St. Austell's Drive, Prestwich, Manchester M25 1LZ (GB). SEAGER, Grenville [GB/GB]; 87 Bury New Road, Whitefield, Manchester M45 7EG (GB). ENTWISTLE, Adrian, Lance [GB/GB]; 410 Rochdale Road, Britannia, Bacup, Lancashire OL12 9SD (GB). CROSBY, Craig, Lee [GB/GB]; 81 Staley Hall Road, Stalybridge, Cheshire SK15 3DP (GB).</p> <p>(74) Agent: ATKINSON, Peter, Birch; Marks & Clerk, Sussex House, 83-85 Mosley Street, Manchester M2 3LG (GB).</p>	<p>(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</p>	
(54) Title: FLOOR COVERING MATERIAL AND METHOD FOR PRODUCING SAME		
<p>(57) Abstract</p> <p>A floor covering material (1) comprising a PVC layer (3) having embedded aggregate (6) for providing surface roughness. The material incorporates a barrier layer (4) of polymeric material other than PVC fused into the upper surface of the PVC layer (3), the aggregate (6) being exposed at the surface of the barrier layer (4).</p>		

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FLOOR COVERING MATERIAL AND METHOD FOR PRODUCING SAME

This invention relates to a material for use as a floor covering as well as a method for the production thereof.

Floor coverings based upon PVC are used extensively. Commonly they are produced by spreading a PVC plastisol onto a carrier substrate, often glass fibre, and then heat-curing the PVC. Such PVC floor coverings have the advantages of being inexpensive, easily coloured/patterned and combine longevity with ease of maintenance. However, a drawback of such floor coverings is that, although when dry they provide an adequate coefficient of friction (COF) to prevent users slipping, the COF can drop to dangerously low levels when the floor covering is wet, e.g. due to water carried by the feet of persons walking on the floor covering or because the floor covering is used in an environment where water may be spilt.

It is generally considered that a floor covering, when wet, should have a COF of at least 30 to prevent slipping. This value is usually achieved by one of the following methods.

- a) An abrasive aggregate such as quartz, silicon carbide or corundum is incorporated into the wear surface during production of the floor covering. The aggregate provides a surface roughness which "breaks up" any water film thereon.
- b) The texture of the floor covering is embossed to produce a high friction pattern.
- c) A water absorbing filling agent such as cork is added as a filler during production.

Most manufactures have concentrated on the first method (i.e. (a)) to increase the COF. In this method the aggregate is embedded into the surface of the plastisol layer while it is still soft during manufacture of the floor covering . This ensures that the final floor covering has a roughened surface to provide the desired frictional properties. Furthermore, the aggregate can be used to give a decorative effect. For example, silicon carbide gives a shiny effect and quartz can be coloured.

However, when aggregates are used to increase the COF of PVC flooring there is a compromise between a higher COF and an increased maintenance effort. A floor covering with embedded aggregates tends to get dirty more quickly than an untreated floor covering as the aggregate removes dirt from footwear. Such dirt is difficult to remove from the surface of the flooring since it becomes embedded in the texture created by the aggregate. This effect is exacerbated by the nature of the plasticised PVC formulation which tends to have a high affinity for dirt and grease. Quite often a rigorous cleaning regime is required for thoroughly removing the dirt and grease and inadequate cleaning can give rise to hygiene problems.

A further problem with plasticised-PVC type floor coverings is that they can stain easily. Thus, for example, oils, fats and greases lead to yellow staining of PVC, which can therefore easily be discoloured when used in a kitchen. Certain cleaning agents also contain dyestuffs that are picked up by the PVC and this is a further source of discoloration. The staining of PVC is obviously undesirable from an aesthetic point of view.

A further problem is that fats (e.g. as may be split in a kitchen) can soften the PVC leading to increased slippiness, undermining the effect of the aggregate.

In the case of PVC floor coverings which do not include aggregates, it is known to incorporate a surface barrier coating which prevents stains. The surface coating reduces the floor covering's susceptibility to picking up stains and dirt. The

coating typically lasts between 6-12 months and further lowers the frequency that the floor covering must be cleaned. However, such a coating cannot be applied over a PVC floor covering having aggregates embedded therein, as the coating covers the aggregate and reduces its efficacy.

It is therefore an object of the present invention to produce a floor covering that provides a sufficient COF, when wet, combined with ease of maintenance.

According to a first aspect of the present invention there is provided a floor covering material comprising a PVC layer and having aggregate embedded in the material for providing surface roughness wherein the material incorporates a barrier layer of polymeric material other than PVC fused into the upper surface of the PVC layer, the aggregate being exposed at the surface of the barrier layer.

The floor covering material of the invention thus incorporates aggregate providing surface roughness and a barrier layer fused into the upper surface of the PVC layer. Since the barrier layer is fused into the upper surface of the PVC layer (and for this reason is other than PVC), the floor covering material comprises the PVC layer, the barrier layer and (between these two layers) a transition region which is comprised of both the PVC and the polymer of the barrier layer. Surface roughness is achieved by ensuring that a portion of the aggregate material is exposed at the surface of the barrier layer. Thus, for example, the aggregate may be proud of the barrier layer or may have an exposed surface at the level of the barrier layer surface. The barrier layer serves to protect the underlying PVC layer from discoloration and softening as described above. The material of the invention thus has the two-fold advantage of slip resistance (as provided by the surface aggregate) and protection of the PVC layer. Moreover the composition of the barrier layer may be chosen to impart at least one further desired characteristic for the floor covering material, e.g. enhanced stain resistance, dirt release and/or heat resistance. By this means, desirable surface properties for the PVC flooring (e.g. enhanced dirt release, stain

resistance etc) can be achieved without adversely affecting slip performance as occurs with conventional coating processes.

Furthermore provided that the aggregate is embedded in the PVC layer then slip resistance is maintained even if the barrier layer becomes worn away. Additionally, even when the barrier layer proper is worn away, there is then exposed the aforementioned transition region which still provides a degree of barrier function.

Preferably the barrier layer is of a cured polymer material but we do not preclude the possibility of the barrier layer being thermoplastic.

Preferably the barrier layer is at least as flexible as the underlying PVC layer so as not to crack during normal use and handling of the product. Preferably also the barrier layer is transparent or translucent.

The barrier layer may for example comprise a polyolefin, (co-)polyester, (co-)polyamide, polyurethane, phenol formaldehyde, epoxy or acrylic polymer or a mixture of the polymers.

It is also preferred that the floor covering material has an embossed surface. Such embossing serves to help retain the aggregate material in the surface of the material.

The aggregate material may for example be quartz, corundum, and/or silicon carbide.

According to a second aspect of the present invention there is provided a method of producing a floor covering material comprising

- (a) spreading a PVC plastisol on a substrate,

(b) distributing over the surface of the plastisol a powder of a film forming, heat fusible polymeric material other than PVC and a particulate aggregate material, and

(c) effecting heating to fuse the plastisol and convert the powder into a film,

steps (b) and (c) being effected such that aggregate is exposed at the surface of the film.

The method of the invention may be effected semi-continuously by withdrawing a web of the substrate material from a roll thereof and moving the travelling web successively through the steps of the method identified above.

In step (a) of the above process, the substrate is for preference glass fibre although other materials may be used. The PVC plastisol may be spread onto the substrate using a knife-over-roller coating process. Typically the plastisol is applied to the substrate to a thickness of 1.5 to 3.5mm.

The powdered polymeric material used in step (b) may be a thermoplastic but is more preferably a material which becomes cured at a subsequent stage in the process. Thus, the polymeric material may be heat curable and become cured in step (c) of the process or may be a radiation (e.g. UV) curable system which is subjected to cross-linking in a step subsequent to (c).

The powder employed in step (b) should be one which is compatible with the PVC plastisol so that the polymer is converted to a film which bonds to the PVC layer in the floor covering. The film of the polymer should have a similar co-efficient of thermal expansion to the PVC layer. Given that the PVC layer is flexible then the

film should be at least as flexible so as not to crack during normal use and handling of the product.

In step (b) of the process. The powder may be distributed over the plastisol either before, after or simultaneously with the aggregate. If the powder is distributed before the aggregate then the powder on the plastisol may be softened (e.g. using a medium wave infra-red heater) to a semi-molten state to allow more ready acceptance of the aggregate onto the surface. If the powder and aggregate are distributed onto the plastisol simultaneously then softening of the powder may once again be effected prior to step (c). Alternatively, as indicated, the aggregate may be distributed over the plastisol prior to the powder. Excess powder. (e.g. that which is covering the aggregate or which has not otherwise become absorbed in the plastisol) may be removed prior to step (c). Such removal may for example be effected by suction, (using a vacuum) or blowing such as by using an air knife.

Typically the amount of powder applied is 10 to 100gm⁻², more preferably 30-70 gm⁻². The powder preferably has a particle size below 200 microns, more preferably below 100 microns. It is particularly preferred that the mean particle size is in the range 40-60 microns. Further details of powders which may be used are given below.

A wide variety of particulate aggregate materials may be used. Suitable examples include quartz, silicon carbide or corundum as conventionally used for providing surface roughness in floor coverings. The particle size of the aggregate is preferably in the range 0.5 to 1.00mm and is incorporated into the surface at a density of 50 to 200g m⁻².

In step (c), the heating may be effected in a drying oven using a temperature of 190-200°C. This will fuse the plastisol and melt the powder polymeric material to form a uniform film on the plastisol surface. If the powder is thermally cross-linkable

then the cross-linking step (c) will be effected whilst the material is in the oven. If the powder is of a uv cross-linkable polymeric system then cross-linking may be effected in a subsequent step using uv lamps.

It is particularly preferred that pressure is applied to the surface of the material (e.g. by an embossing operation) after the heating operation (step (c)) but whilst the plastisol is still soft to produce a textured surface. This pressure application step assists in retention of the aggregate in the surface.

The powdered polymeric material used in step (b) may be a thermoplastic (thermofusible) material. Thermofusible materials flow to form a molten film on the plastisol and solidify on cooling. Examples of thermofusible materials which may be used include:

- i) polyester co-polymers (e.g. having a DSC melting range of 90-120°C, and a Melt Flow Index (MFI) of 15-40g/10 min under an applied load of 2.16 kg);
- ii) co-polyamides (e.g. having a DSC melting range of 80-130°C, and an MFI of 15-95g/10 min under an applied load of 2.16 kg); and
- iii) polyolefins (e.g. having a DSC melting range 100-135°C, and an MFI of 10-95 g/10 min under an applied load of 2.16 kg).

Examples of polyolefins which may be used include polyethylenes and ethylene-propylene copolymers.

Thermofusible polymeric coatings (e.g. of the type defined under (i)-(iii) above) give improved soiling, chemical and staining resistance with no adverse effects

on the slip resistance of the floor covering. The thermofusible polymers can either be used alone or blended to suit specific requirements.

It is however more preferred to use, as the polymeric material for step (b), a curable resin system. Such a resin system may be a thermosetting resin or a uv curable resin.

Thermosettable materials flow into a molten film on the plastisol substrate and are cross-linked by a heat activated cross-linking mechanism. Examples of thermosettable polymeric systems which may be used in the method of the invention include:

- a) epoxy resins, e.g. phenol formaldehyde resins and epichlorhydrin cured with aminic curing agents known in the art, such as benzyldimethylamine and dicyanamide;
- b) polyesters with hydroxyl or carboxyl end groups, cured with blocked isocyanates, e.g. caprolactam-isocyanate products;
- c) polyurethanes cured with blocked isocyanates; and
- d) acrylics incorporating epoxy resins and polyesters to allow curing with blocked isocyanates.

Thermosettable polymeric materials give the same benefits as those of thermofusible polymeric coatings but with the additional advantage of enhanced durability and staining resistance. The polymers can either be used alone or blended to suit specific requirements.

UV curable polymeric materials flow to form a molten film on the plastisol during step (c) and may cross-linked by the action of uv light subsequent to step (c). The following compounds may for example, be used as UV curable coatings on the floor covering:

- a) UV curable polyesters e.g. unsaturated polyesters, cross-linked by free radical initiated polymerisation using curing agents known in the art, e.g. diacetoneacrylamide; and
- b) Bifunctional epoxy resins, cross-linked by cationic photoinitiated polymerisation using photoinitiators known in the art e.g. ferrocenium salts.

UV curable polymeric materials demonstrate similar benefits to those of thermoset polymeric coatings but with additional processing advantages in that the cross-linking reaction can be controlled separately from the plastisol fusion process. . The polymers can either be used alone or blended to suit specific requirements.

For UV curable systems employed in the invention, there may be some thermal cross-linking in step (c) and depending on the resin used the UV-curing step may also need to be effected at elevated temperature.

For all embodiments of the method of the invention, it is possible for the powder (which forms the barrier layer) to include at least one of a flow modifying agent, a flame retardant agent, a biocide, a gloss modifier, a matting agent or other coating technology additive well known in the art.

In a typical embodiment of the method of the invention, a floor covering material is formed by the following steps.

(i) PVC plastisol is spread onto a substrate web (e.g. glass fibre) drawn from a roll thereof using a knife-over-roller coating process.

(ii) Powder (for forming the barrier layer) and aggregate are distributed over the plastisol either simultaneously or in any order. If the powder is applied first, then it may be softened, (e.g. using a MWIR) prior to application of the aggregate. If the

aggregate is applied prior to the powder then excess powder (i.e. that which is non-absorbed in, or not adhered to, the plastisol) may be removed, e.g. by using suction or by blowing-off with an air knife prior to step (iii) below.

(iii) The web material resulting from (ii) is then passed through an oven to fuse the plastisol and convert the powder to a film. If the powder is of a thermally curable resin then cross-linking will be effected in the oven. If however the powder is of a uv-curable resin then there would be a subsequent uv-curing stage.

(iv) Optionally the web may be embossed. In the case where there is a uv-curing stage, embossing preferably takes place before uv-curing but can take place after.

(v) The thus formed web material may then be passed through curing and accumulator stages as conventional in the manufacture of PVC flooring.

The invention will be further described by way of example only with reference to Fig 1 of the accompanying drawings which illustrates one embodiment of floor covering in accordance with the invention.

As shown in the drawing, a floor-covering 1 in accordance with the invention, comprises a backing layer 2 (e.g. of glass fibre), a PVC layer 3 (as represented by the small triangles) an upper barrier layer 4 (produced from the powdered material discussed above) and a transition region 5 formed between layers 3 and 4. This transition region 5 is, in effect, where the barrier layer 4 is fused to the PVC layer 3 and incorporates both the material of the barrier layer and PVC. Also included in the floor covering 1 are particles of aggregate 6 (e.g. silicone carbide) which are embedded in the PVC layer and which are exposed at the barrier layer.

The method of the invention may be effected semi-continuously by withdrawing a web of the substrate material from a roll thereof and moving the travelling web successively through the steps of the method identified above.

CLAIMS

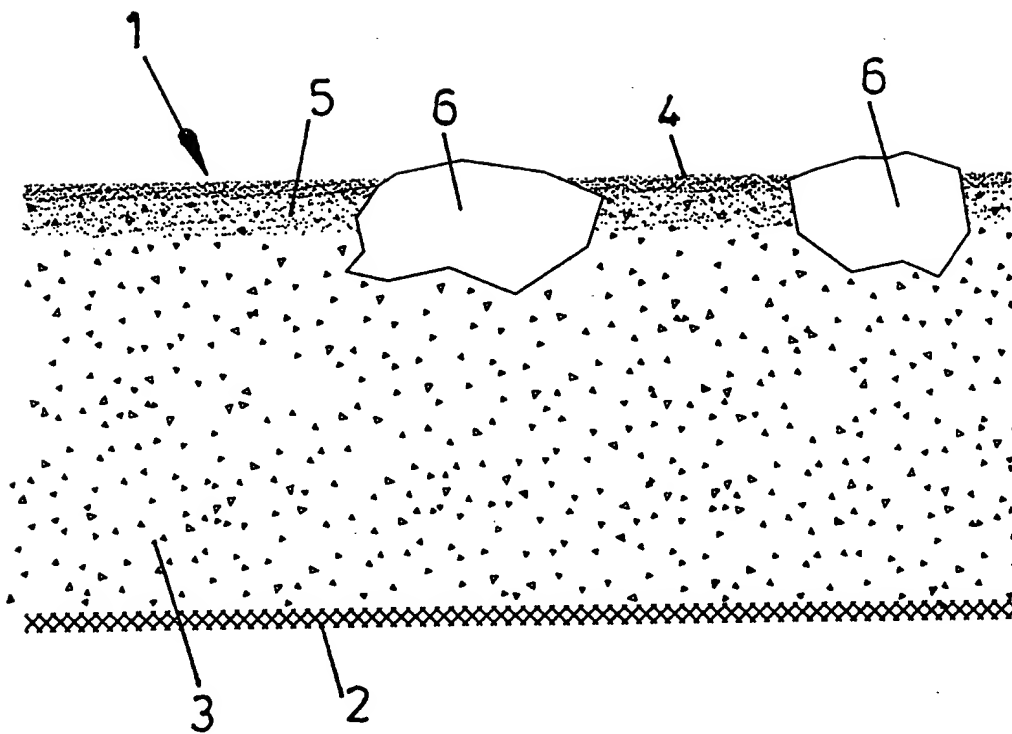
1. A floor covering material comprising a PVC layer and having aggregate embedded in the material for providing surface roughness wherein the material incorporates a barrier layer of polymeric material other than PVC fused into the upper surface of the PVC layer, the aggregate being exposed at the surface of the barrier layer.
2. A material as claimed in claim 1 wherein the barrier layer is of a cured polymeric material.
3. A material as claimed in claim 1 wherein the barrier layer is of a thermoplastic material.
4. A material as claimed in any one of claims 1 to 3 wherein the barrier layer is at least as flexible as the underlying PVC layer.
5. A material as claimed in any one of claims 1 to 4 wherein the barrier layer is transparent or translucent.
6. A material as claimed in any one of claims 1 to 5 wherein the polymeric material of the barrier layer provides enhanced dirt release and/or stain resistance in comparison to the PVC.
7. A material as claimed in any one of claims 1 to 6 wherein the barrier layer comprises a polyolefin, (co-)polyester, (co-)polyamide, polyurethane, phenol formaldehyde, epoxy or acrylic polymer or a mixture thereof.

8. A material as claimed in any one of claims 1 to 7 wherein the floor covering material has an embossed surface.
9. A material as claimed in any one of claims 1 to 8 wherein the aggregate is quartz, corundum, and/or silicon carbide.
10. A method of producing a floor covering material comprising
 - (a) spreading a PVC plastisol on a substrate,
 - (b) distributing over the surface of the plastisol a powder of a film forming, heat fusible polymeric material other than PVC and a particulate aggregate material, and
 - (c) effecting heating to fuse the plastisol and convert the powder into a film,steps (b) and (c) being effected such that aggregate is exposed at the surface of the film.
11. A method as claimed in claim 10 wherein the powder is distributed over the plastisol prior to the aggregate material.
12. A method as claimed in claim 11 wherein the powder applied to the plastisol is softened prior to distribution of the aggregate.
13. A method as claimed in claim 10 wherein the powder is distributed over the plastisol simultaneously with the aggregate.

14. A method as claimed in claim 10 wherein the aggregate is distributed over the plastisol prior to the powder .
15. A method as claimed in claim 14 wherein excess powder is removed from the plastisol prior to step (c).
16. A method as claimed in claim 15 wherein the excess powder is removed by suction.
17. A method as claimed in any one of claims 10 to 16 wherein the powder is a thermoplastic material.
18. A method as claimed in any one of claims 10 to 16 wherein the powder is of a curable resin system.
19. A method as claimed in claim 18 wherein said resin system is cured by heat and curing is effected in step (c).
20. A method as claimed in claim 18 wherein the resin system is curable by UV-radiation.
21. A method as claimed in claim 20 wherein UV curing is effected subsequent to step (c).
22. A method as claimed in any one of claims 10 to 21 wherein the powder comprises a polyolefin, (co-)polyester, (co-)polyamide, polyurethane, phenol formaldehyde, epoxy or acrylic polymer or a mixture thereof.
23. A method as claimed in any one of claims 10 to 22 wherein embossing is applied subsequent to step (c).

24. A method as claimed in any one of claims 10 to 23 wherein the aggregate is quartz, corundum and/or silicon carbide.

25. A method as claimed in any one of claims 10 to 24 wherein the powder incorporates at least one of a flow modifying agent, a flame retardant, a biocide, a gloss modifier and a matting agent.

1-1

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/03169

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 D06N7/00 B29C70/64

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 D06N B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	EP 0 494 658 A (NORTON CO) 15 July 1992 (1992-07-15) claims 1,14,15 ----	1,2,4-7, 9 10-25
X A	US 4 196 243 A (SACHS PETER R ET AL) 1 April 1980 (1980-04-01) claims 1-6 ----	1,2,4-7 10-25
A	US 5 787 655 A (SAYLOR JR EDWARD T) 4 August 1998 (1998-08-04) claims 8-11 -----	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

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- "P" document published prior to the international filing date but later than the priority date claimed

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/03169

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